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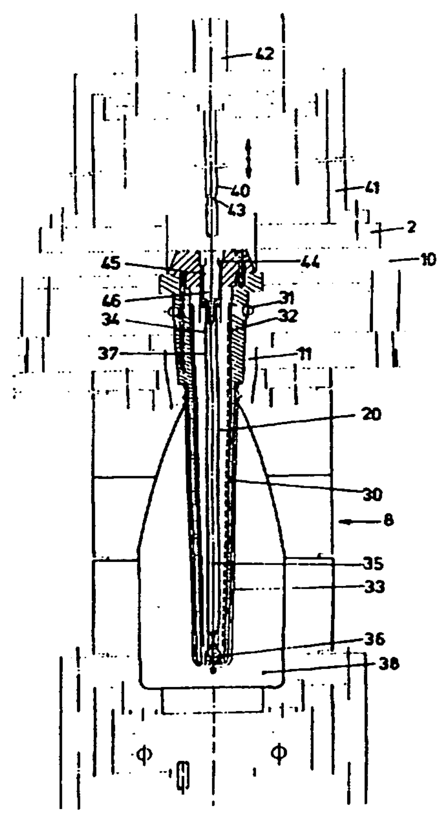
(54) Title: METHOD AND APPARATUS FOR MANUFACTURING PLASTIC CONTAINERS, SUITABLE IN PARTICULAR FOR POLYCARBONATE BOTTLES

(57) Abstract

Method and apparatus for manufacturing plastic containers, wherein first a preform (33) is formed in an injection molding station (6, 3); then, after optionally passing a conditioning station (4, 7), the preform (33) is inflated in a blowing station (5, 8) to form a container having the ultimately desired shape; and finally, the container is removed in an ejection station (9), wherein each preform (33) suspending in a neckring (11, 12, 13, 14) and internally supported by a heated core (20, 21, 22, 23) extending into the preform from above, is conveyed from the injection molding station (3, 6) to the blowing station (5, 8), and wherein the core is then moved along with the inflated container to the ejection station (9) and is then moved to an injection molding station (3, 6) again.



Title: Method and apparatus for manufacturing plastic containers, suitable in particular for polycarbonate bottles.

The invention relates to a method for manufacturing plastic containers, suitable in particular for the manufacture of polycarbonate bottles, wherein first a preform is formed in an injection molding station; then, the preform is inflated in a blowing station to form a container having the ultimately desired form; and finally, the container is removed in an ejection station.

The invention also relates to an apparatus for using the method.

Such method and apparatus are known from practice. In the known technique, an injection molding apparatus is used having a horizontal machine bed, a frameplate which is mounted above the machine bed and which is stationary or can be moved up and down, and a carousel plate mounted under the frameplate and capable of rotating about a central axis. The machine bed carries a half of an injection mold having one or more mold cavities, a blowing mold and an ejection station. Opposite this half of the injection mold, the frameplate is provided with opening via which one or more cores can be introduced into the mold cavity (cavities). The frameplate further carries, at the location of the blowing station, means for stretching and inflating the preforms. Usually, a conditioning station is further present between the injection molding station and the blowing station, where the preforms to be inflated are in thermal respect brought into a suitable condition for stretching and inflating.

The carousel plate has its bottom side provided, at positions corresponding to each station, with one or more neckrings capable of retaining the preforms formed in the injection molding station after the cores have been drawn from the mold cavities. When the cores have been moved up relative to the frameplate and when, if necessary, the frameplate has also been moved upwards relative to the

machine bed, the preforms produced are suspended in the neckrings. When the carousel plate is subsequently rotated, the preforms are moved via the conditioning station to the blowing station, and then, the containers obtained, still suspending from the neckrings, are passed to the ejection station, where the neckrings are opened.

The above-described technique is also referred to as the single-stage method, because the containers are manufactured in one single pass. This technique has hitherto been employed for PET bottles. A drawback of PET bottles is that they cannot be cleaned at a sufficiently high temperature in order that they can for instance be used as refillable bottle for milk. At temperatures of 70°C and higher, there is the danger of a PET bottle shrinking. This drawback does not exist when a different material is used, such as polycarbonate. Bottles of polycarbonate can be cleaned at high temperature and are therefore suitable for use as, for instance, refillable milk bottle.

The fact that polycarbonate containers can be cleaned at a higher temperature than for instance PET bottles also means that the injection molding of the preforms for polycarbonate bottles and the inflation thereof should likewise take place at a higher temperature (180-190°C). In the known technique, however, this causes problems, because the preforms, after being injection molded, are displaced to the subsequent stations while freely suspending from the neckrings. During the rotational movement of the carousel plate, the preforms may become deformed, which is of course highly undesirable. This problem can be slightly reduced by inflating the preforms at a lower temperature (about 160°C). In that case, however, stresses occur in the end product, which render the end product susceptible to damage. This can again be compensated by a greater wall thickness, yet this renders the container heavier and more expensive.

The object of the invention is to overcome the problems outlined and generally to provide a method and apparatus that

are suitable for manufacturing containers suitable for cleaning at high temperature, such as for instance polycarbonate bottles. To this end, according to the invention, a method of the above-described type is characterized in that each preform suspending in a neckring and internally supported by a heated core extending into the preform from above, is conveyed from the injection molding station to the blowing station, and that the core is then moved along with the inflated container to the ejection station and is then moved to an injection molding station again.

According to the invention, an apparatus of the above-described type is characterized in that the core moves along with the carousel plate and the associated neckring in order to support the preform during the movement from the injection molding station to the blowing station.

Hereinafter, the invention will be described in more detail with reference to the accompanying drawings of an exemplary embodiment.

Fig. 1 and Fig. 2 schematically show, in top plan view and in side elevational view, an example of a known apparatus for manufacturing plastic containers;

Fig. 3 and Fig. 4 illustrate in a similar manner an example of a method and apparatus according to the invention; and

Fig. 5 schematically shows an example of a blowing station of an apparatus according to the invention.

Figs. 1 and 2 schematically illustrate the operation of a known apparatus for manufacturing plastic containers according to the blowing-mold principle. The known apparatus has been designed for producing PET bottles and is of a type that is for instance marketed by Nissei ASB Machine Co. Ltd. The known machine comprises a stationary machine bed 1 and a frameplate 2 mounted above the machine bed, which frameplate, depending on the type of molds used, is fixedly mounted or is movable up and down. The machine bed carries, distributed

along its circumference, an injection mold part 3 having one or more mold cavities, a conditioning device 4, and a blowing mold part 5, which form part of an injection station 6, a conditioning station 7 and a blowing station 8. If the parts 3, 4 and 5 each consist of two parts that have a vertical separating face or are movable up and down relative to the machine bed, as is usually the case with the injection mold part and the conditioning device, the frameplate need not be movable up and down. However, if the parts 3, 4 and 5 are not dividable, the frameplate 2 and/or the parts 3 and /or 4 and/or 5 should be movable up and down for being able to convey the containers from one station to the other. In this example, these stations are in each case positioned at an angular distance of 90° relative to each other, as shown in Fig. 2. Further, at 90° beyond the blowing station 8, an ejection station 9 is positioned.

Mounted under the frameplate 2 is a rotating carousel plate 10, carrying one or more neckrings 11, 12, 13 at positions corresponding to the stations. Further, located above the frameplate at the location of the injection station 6 are one or more cores 14 that can be lowered through the corresponding neckrings 11 into the injection mold part 3 to form, during the injection phase, one or more preforms. After a preform has been obtained in this manner, the mold formed by the mold part 3 and the core 14 opens in that either the mold part 3 opens or moves downwards, or the frameplate 2 and the core 14 move upwards. At any rate, the core 14 moves upwards relative to the frameplate, so that the preform just formed is freely suspending from the neckring 11 and the carousel plate is free to rotate through 90° in the direction of the arrow 15. The just formed preform is thus moved to the conditioning station for being prepared for the blowing treatment in the blowing station. Simultaneously, at least one new preform is formed in the injection station. Subsequently, the carousel plate rotates through 90° again, so that the conditioned preform reaches the blowing

station 8. In the blowing station, the preform is received in a blowing mold and inflated to obtain the desired shape. After opening of the blowing mold, the carousel plate rotates through 90° again, so that the ready container reaches the ejection station 9. At the same time, a just conditioned preform reaches the blowing station 8 and a just formed preform reaches the conditioning station 7. During all phases of conveyance, the preform is suspended from a neckring 11.

In the blowing station, in preparation of the inflation of the preform, the preform is first stretched by means of a stretching pin which is inserted through the neckring into the preform and pushes the bottom of the preform away in a direction away from the neckring.

The method and apparatus according to the invention illustrated in Figs. 3 and 4 differ from the above-described known method and apparatus in that each neckring 11, 12, 13 is now provided with a core 20, 21, 22 rotating along with the carousel plate. In effect, during the conveyance between the injection station and the conditioning station and between the conditioning station and the blowing station, and also during their stay in those stations, the hot preforms are supported and retained by a neckring and a core. This technique enables displacement of the preforms in weaker condition. Hence, the preforms can be warmer than in the case of the known technique. This in turn enables for instance processing polycarbonate preforms at a suitable high temperature and/or conveying the preforms more rapidly after the injection phase.

The stabilizing effect of the cores moving along can further be enhanced by rendering the cores and, accordingly, the preforms longer than is conventional. In this connection, it is observed that when PET is used as starting material, it is necessary to stretch a preform in the longitudinal direction before inflating the preform, because only after the stretching operation the desired molecular structure with the associated mechanical strength is formed. However, it has

been found that this effect does not arise with polycarbonate, and that a polycarbonate preform need not be stretched in the longitudinal direction, or only to a slight degree. With PET preforms, the stretching treatment results in a length increase to the order of 50%. However, according to the invention, for the processing of polycarbonate preforms, preferably cores are used whose lengths differ from that of the final product by some centimeters only. Hence, through inflation, a length increase to the order of for instance about 15% takes place. In principle, the core and, accordingly, the preform could even have a length which substantially corresponds to that of the final product.

According to the invention, cores are used that have a heated shell and an air duct which is closed by a central pin during the injection phase and the conditioning phase. In the blowing station, the air duct is opened, allowing the preform to be inflated into the eventual shape, as will be further described hereinbelow.

Fig. 5 schematically shows an example of a core 20 according to the invention, located in the blowing station 8. The core has a heated shell 30, which in this example is heated by hot oil circulating via a duct 31,32. The preform to be inflated is indicated at 33. Located centrally in the core, in a longitudinal bore 34, is a pin 35 provided, at the free end of the core, with a closing member 36, which, in this example, is a conical plug. The bore is slightly larger than the pin, so that an annular air duct 37 is present around the pin, which duct is closed by the plug 36 during the injection phase. Alternatively, the pin may also have an internal air duct.

In the blowing station, the pin 35 is pushed through a slight or larger distance, depending on the material of the container, beyond the end of the core into the blowing cavity 38. In the case of a PET preform, the pin is moved down to the bottom of the blowing cavity, so that the desired stretching treatment takes place. Also, via the air duct, air

is blown into the preform. This is possible because the conical plug 36 no longer closes off as soon as the pin has been slightly displaced.

In the case of a polycarbonate preform, the procedure is preferably as follows. First, the pin is slid out of the core through a slight distance, for instance 0.5-1 mm. As a result, the closing member 36 opens, permitting air to be blown into the preform. The air supply is continued, involving the wall of the preform being first inflated around the free end of the core, to form a kind of balloon. When the balloon lies against the bottom of the blowing cavity, the pin 35 is pushed down further to fix the balloon in the blowing cavity. Next, the preform is further inflated until the end product having the shape of the blowing cavity has been obtained. After that, the blowing mold opens and the carousel plate rotates further through 90°, so that in the ejection station, the end product can be removed from the core and out of the neckring.

The operation of the pin 35 takes place by means of a pusher pin 40, which is located in a frame 41 mounted above the blowing station and can be operated by a cylinder 42. The pusher pin 40 can be temporarily coupled to the central pin located in the core in one of the manners known therefor. In the example shown, a snap connection is used, as is also used for exchangeable hand tools. The pusher pin has a constriction 43 adjacent its lower end, which constriction can cooperate with balls 44 or the like around a receiving cavity 45 and a coupling member 46 of the central pin 35. Other coupling methods, for instance by means of a bayonet closure or the like, are possible.

As observed, the cores are heated by hot oil. As the cores rotate along with the carousel plate, the oil should be fed via a tube or hose having a central universal joint, as shown in Fig. 3 at 50, and conduits 51-54 that rotate along. For driving the carousel plate, use can then be made of a

hollow shaft or, as shown in Fig. 3, a gear ring 55 driven by a drive wheel 56 of a motor, or an eccentric drive mechanism.

It is observed that after the foregoing, various modifications will readily occur to a skilled person. For instance, if so desired, the cores may also be electrically heatable. Such modifications are understood to fall within the framework of the invention.

Claims

1. A method for manufacturing plastic containers, wherein first a preform is formed in an injection molding station; then, after optionally passing a conditioning station, the preform is inflated in a blowing station to form a container having the ultimately desired shape; and finally, the container is removed in an ejection station, characterized in that each preform suspending in a neckring and internally supported by a heated core extending into the preform from above, is conveyed from the injection molding station to the blowing station, and that the core is then moved along with the inflated container to the ejection station and is then moved to an injection molding station again.

2. A method according to claim 1, characterized in that cores are used that are provided with a central pin, which in the injection molding position closes an air duct in the core and which in the blowing station is temporarily coupled to a push member whereby the central pin relative to the core is pushed further into the blowing cavity of the blowing station for releasing the air duct.

3. A method according to claim 2, characterized in that the central pin is used for performing a stretching treatment on the preform to be inflated.

4. A method according to claim 2, characterized in that during the manufacture of polycarbonate containers and similar containers, the pin is pushed into the blowing cavity to a very slight extent only, that the preform is then inflated until the preform rests at least partially against the bottom of the blowing cavity, and that the pin is then moved further into the blowing cavity until the pin fixes the part of the preform that lies against the bottom, and that the preform is then further inflated.

5. A method according to claim 4, characterized in that cores are used which extend relatively far into the blowing cavity.

6. A method according to claim 5, characterized in that cores are used which have such lengths that the preforms are extended in the blowing station to the order of 25% or less, more in particular 15% or less.

7. An apparatus for manufacturing plastic containers comprising a carousel plate provided with neckrings, which carousel plate, in operation, is driven for rotation in order to pass the neckrings from an injection molding station, optionally along a conditioning station, to a blowing station and then via an ejection station to an injection molding station again, wherein in the injection molding station each time at least one preform is formed on a core extending into a mold cavity, said preform being inflated in the blowing station to form a container, characterized in that the core moves along with the carousel plate and the associated neckring so as to support the preform during the movement from the injection molding station to the blowing station.

8. An apparatus according to claim 7, characterized in that the cores comprise a central pin provided in the cores, which in the injection molding position closes an air duct formed in the cores, and that operating means are provided in the blowing station which are capable of temporarily cooperating with the central pin for causing said central pin to move into the blowing cavity of the blowing station and release the air duct.

9. An apparatus according to claim 8, characterized in that the operating means comprise a pusher pin mounted above the blowing station and movable up and down, wherein the pusher pin and the central pin are provided with interlocking coupling members.

10. An apparatus according to any one of claims 7-9, in particular suitable for manufacturing polycarbonate containers or similar containers, characterized in that

the cores are relatively long relative to the depth of the blowing cavity.

11. An apparatus according to claim 10, characterized in that the cores have a length to the order of 75% or more, in particular to the order of 85% or more of the depth of the blowing cavity.

12. An apparatus according to any one of claims 7-11, characterized in that the cores have a heatable shell.

13. An apparatus according to claim 12, characterized in that the cores are each coupled to an oil conduit for the feed of hot oil.

14. An apparatus according to claim 13, characterized by a central oil feed conduit which, via a universal joint, is connected to the separate oil conduits leading to the cores.

15. An apparatus according to any one of claims 7-14, characterized by an eccentric drive device for the carousel plate.

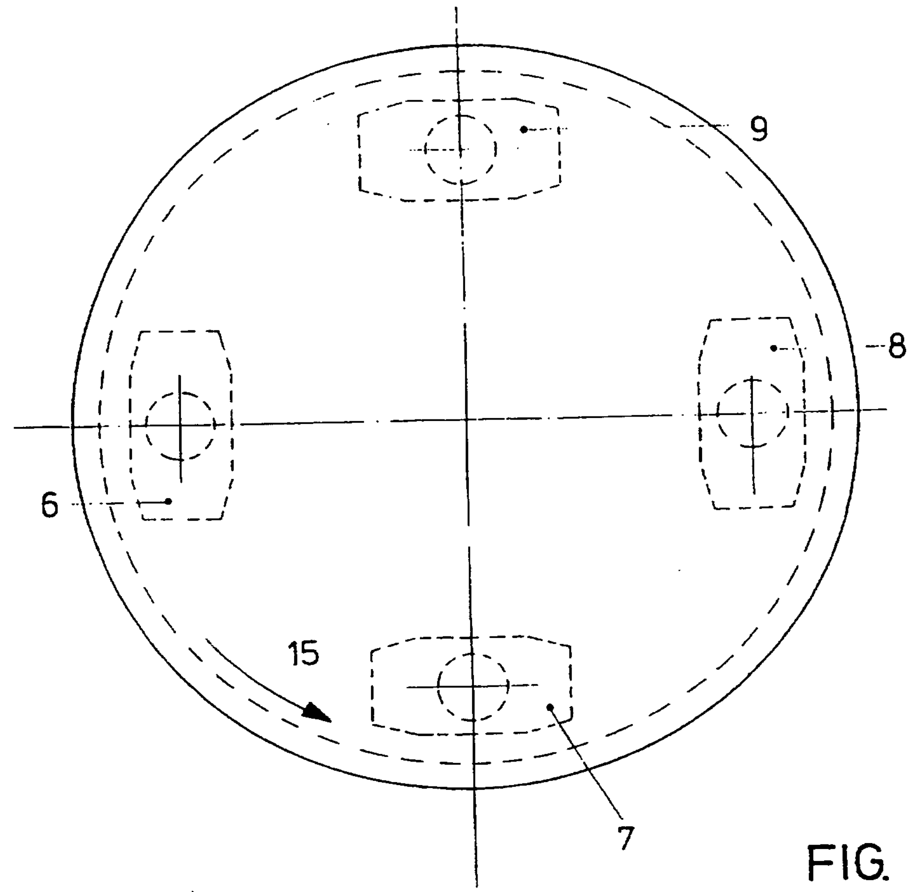


FIG. 1

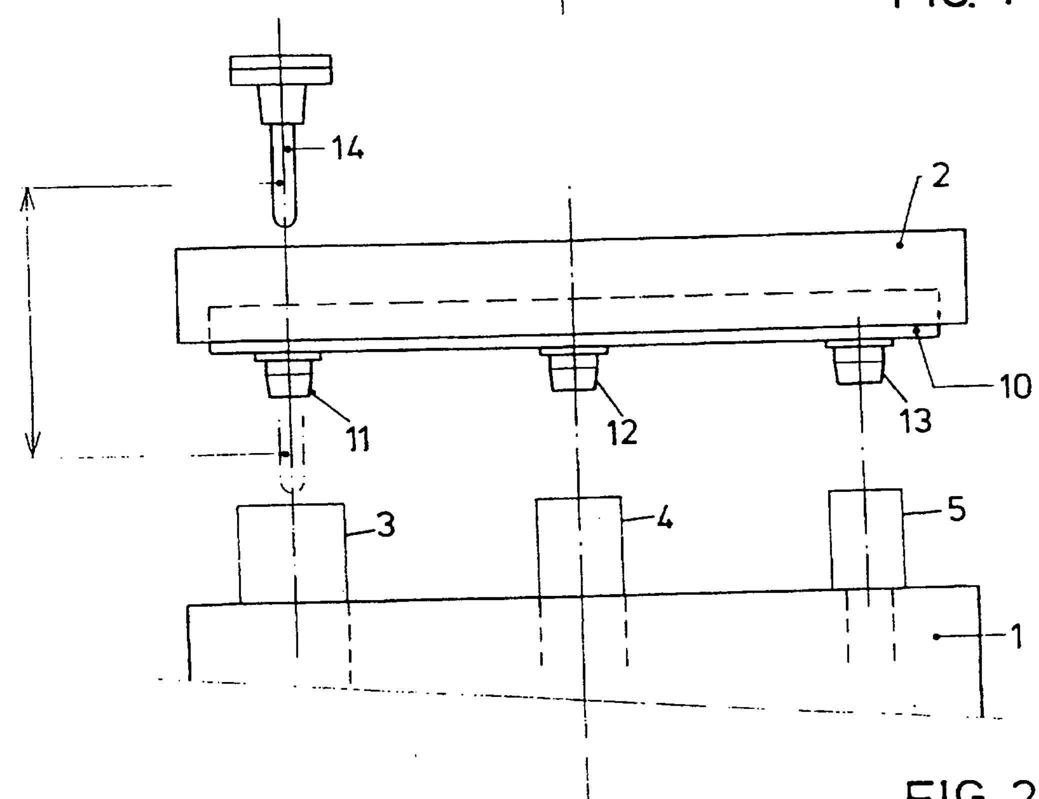


FIG. 2

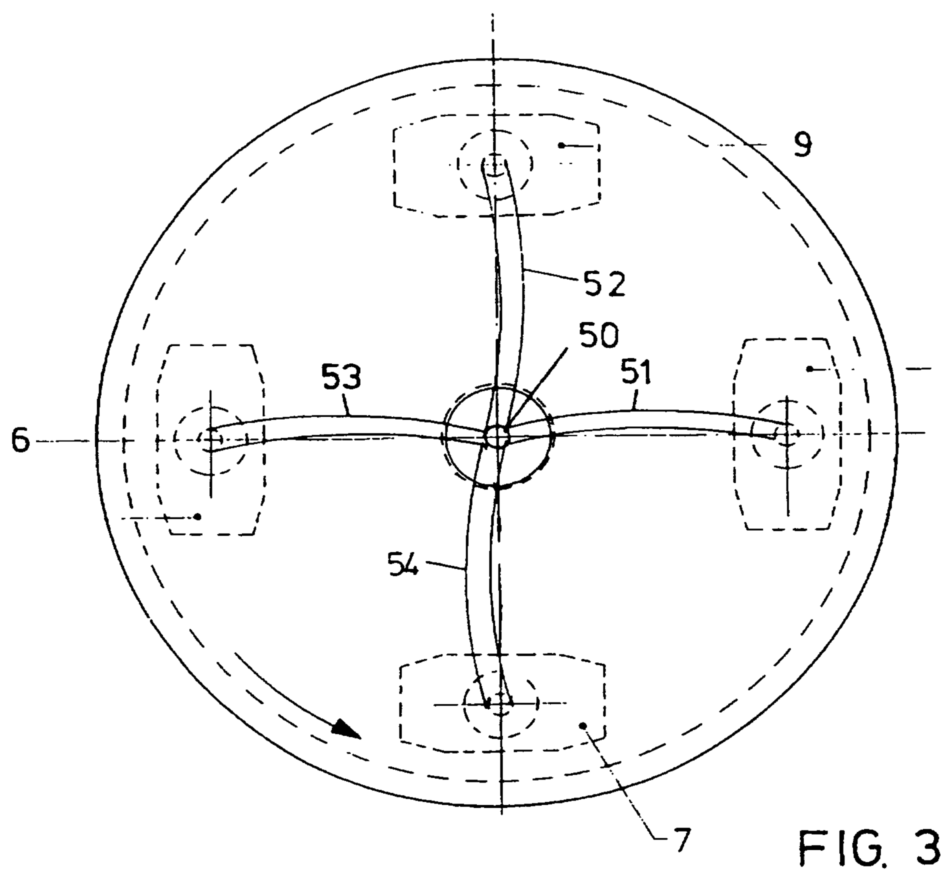


FIG. 3

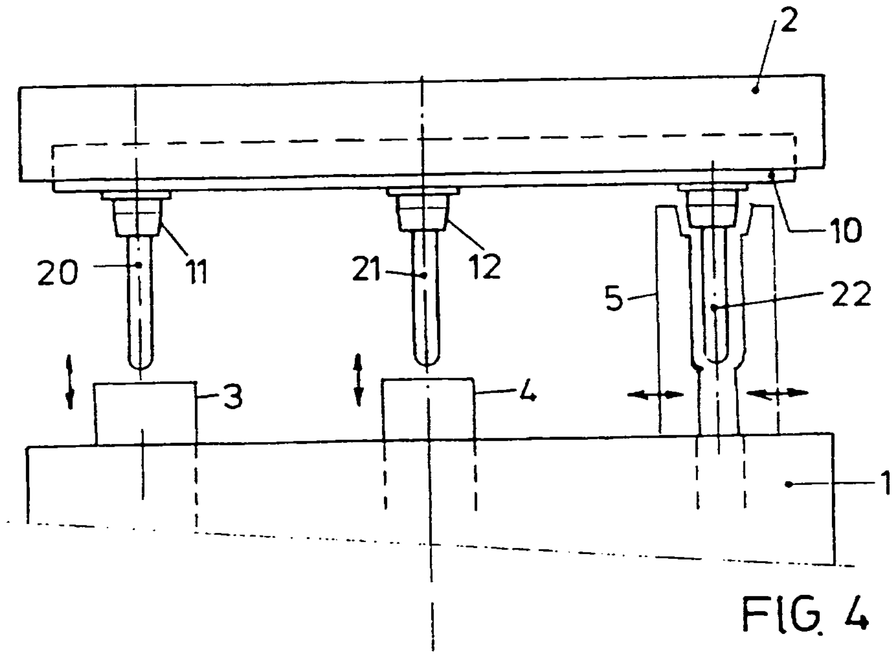


FIG. 4

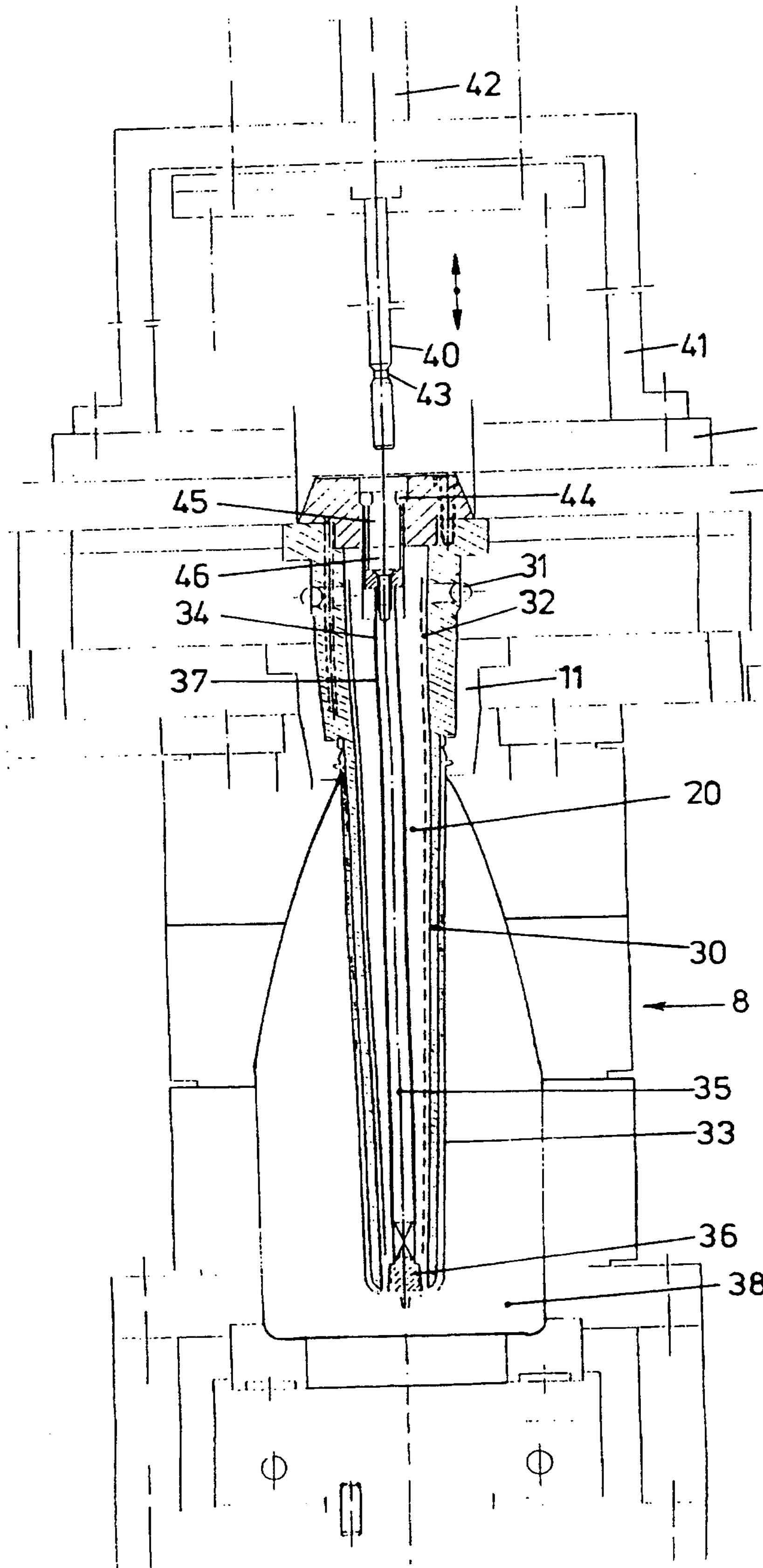


FIG. 5

INTERNATIONAL SEARCH REPORT

Inte nal Application No
PCT/NL 97/00393

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B29C49/06 B29C49/64

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 1 406 520 A (OWENS ILLINOIS GLASS COMPANY) 22 November 1965 see the whole document ---	1-3,7,8, 12-15
X	US 4 473 515 A (RYDER LEONARD B) 25 September 1984 see claims; figures ---	1-5, 7-10, 12-15
X	NL 7 215 474 A (CONTINETAL CAN COMPANY) 21 May 1973 see claims; figures; example ---	1-5, 7-10, 12-15
A	EP 0 256 777 A (JOHNSON SERVICE CO) 24 February 1988 see column 4, line 48 - column 5, line 27; figures ---	1-15

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 664 201 A (ENICHEM SPA) 26 July 1995 see claim 1; figures	1,2,4,7, 10
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